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A novel, automated multiple-arc stereotactic radiosurgery (SRS) technique reduces dose to the brain, optic nerves and chiasm for patients with intracranial meningioma compared to those treated with roboticbased technique

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Abstract

Objectives: A novel, automated non-coplanar multiple-arc technique was recently developed to streamline intracranial SRS by simplifying the planning process and automating the couch motion during treatment delivery. This study aims to compare dosimetric quality of this new HyperArc technique with those obtained from robotic-based CyberKnife technique. Methods: Twenty patients with single intracranial meningioma were retrospectively selected. Ten patients had the tumors near the optic structures. The median tumor volume was 7.7 cc (range, 0.4-35.0). These patients received a prescription dose of 12-25 Gy in 1-5 fractions with robotic-based radiosurgery. All 20 patients were replanned with the new multiple-arc technique and compared to the clinical plans. Dosimetric quality was evaluated by tumor coverage, conformity index (CI), homogeneity index (HI), gradient index (GI), volume of the brain receiving 4, 8, and 12 Gy, maximum dose delivered to the optic nerves and chiasm, and number of monitor units (MUs). Paired student's t-test was performed with a significance level of 0.05. Results: Although the new multiple-arc SRS plans achieved similar tumor coverage (99.4% ± 0.7% vs. 98.6% ± 2.0%), CI (1.33 ± 0.38 vs. 1.27 ± 0.14), HI (1.25 ± 0.02 vs. 1.25 ± 0), and GI (3.08 ± 0.74 vs. 3.39 ± 0.81) compared to the robotic-based SRS plans, multiple-arc SRS technique significantly reduced the volume of the brain receiving 4, 8, and 12 Gy and spared optic nerves and chiasm better ($p<0.05$). In addition, multiple-arc SRS plans used significantly fewer MUs (3058 ± 1574 vs. 20314 ± 10979) compared to the robotic-based plans. Conclusions: Both the novel HyperArc SRS technique and robotic-based SRS technique generated dosimetrically acceptable plans for intracranial meningioma cases. HyperArc plans had less dose spread in the brain and better sparing of optic nerves and chiasm with fewer MUs.

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